NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

IRRIGATION FIELD DITCH

(ft)
CODE 388

DEFINITION

A permanent irrigation ditch constructed to convey water from the source of supply to a field or fields in a farm distribution system.

SCOPE

This standard applies to open channels and elevated ditches of 25 ft^3/s or less capacity formed in and with earth materials. It does not include canals and laterals or ditches constructed and removed during a season and ditches shaped or constructed for lining installations or irrigation canals or laterals that deliver water to a farm.

PURPOSE

To prevent erosion or loss of water quality or damage to the land, to make possible proper irrigation water use, and to efficiently convey water to minimize conveyance losses.

CONDITIONS WHERE PRACTICE APPLIES

Field ditches shall serve an integral part of an irrigation water distribution system designed to facilitate the conservation use of soil and water resources.

Water supplies and irrigation deliveries for the area served shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Field ditches shall be constructed in earth material that contains enough fines to prevent excessive seepage losses and where shrinkage cracks will not endanger the ditch. The sealing effect of sediment carried in the irrigation water may be considered.

DESIGN CRITERIA

Capacity requirements. Field ditches shall have the capacity to deliver to the field a flow adequate to meet:

1. The design peak consumptive use of the crops to be grown in the field, with proper provisions for the expected field irrigation efficiency.

2. The largest irrigation stream required for the irrigation methods planned for the field.

The capacity shall be increased to provide for the additional flow required to compensate for the ditch seepage loss and to safely carry surface runoff from adjacent lands that must be transported to waterways or overflow points. For capacity design, the value of "n" shall be selected according to the material in which the ditch is constructed, the alinement and hydraulic radius, and additional retardance because of weeds or moss.

Velocities. Field ditches shall be designed to develop velocities that are nonerosive for the soil materials through which they pass. Local information on the velocity limit for specific soils shall be used if available. If such information is not available, the maximum design velocity shall not exceed those shown in figure 6-2, chapter 6, TR-25.

Field ditches shall be designed with enough capacity to carry the required flows at the velocities that will be developed under the maximum probable retardance conditions.

For checking designs to see that velocities do not exceed permissible values, a Manning's "n" no greater than 0.025 shall be used, and applicable criteria in the SCS standard for open channels (582) shall be followed.

NRCS, LA
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Cross section. Freeboard in field ditches shall be not less than one-third of the maximum design depth of water. Side slopes shall be stable. The top width of banks as measured at the elevation providing the required freeboard shall be not less than 12 in. and shall equal or exceed the flow depth.

If a field ditch is to be constructed on an embankment, the side slopes of the embankment shall not be steeper than:

Height to water surface on centerline of fill	Steepest allowable side slope of fill
Less than 3 ft	1-1/2:1
3-6 ft	2:1
More than 6 ft	2-1/2:1

Water surface elevations. All field ditches shall be designed so that the water surface elevations at field takeout points are high enough to provide the required flow onto the field surface. If ditch checks or other control structures are to be used to provide the necessary head, the backwater effect must be considered in computing freeboard requirements. The required elevation of the water surface above the field surface will vary with the type of takeout structure or device used and the amount of water to be delivered through each. A minimum head of 4 in. shall be provided.

Related structures. Erosion- or water-control structures, culverts, diversions, or other related structures needed to supplement the field ditch shall be designed and installed to meet SCS standards for the particular structure and type of construction.

IRRIGATION FIELD DITCH SPECIFICATIONS

FOUNDATION PREPARATION

The foundation area for all ditch embankments and ditch pads shall be cleared of all trees, weeds, sods, loose rock, or other material not suitable for the subgrade.

PLACEMENT OF EARTHFILL

Earthfill embankments shall be constructed to the neat lines and grades shown on the plans and established at the field location. Embankment materials shall be free of brush, roots, sod, large rocks, or other material not suitable for making compacted fills. The moisture content and methods of placing and compacting fill material shall be of such that a firm, stable embankment results. The fill material shall be placed in horizontal lifts of such thickness that proper compaction and prescribed densities are obtained.

EXCAVATION

Excavation shall be to the neat lines and grades shown on the plans and established at the field location. Excavated materials shall be used in designated fill locations or spoil areas.

Over excavation in the channel area or overfill on the ditch banks shall be permissible if it does not interfere with the function of the ditch or the related structures and if the finished section generally is smooth.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing irrigation field ditches shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purposes.

CONSTRUCTION OPERATIONS

Construction operations shall be done in such a manner that erosion and air and water pollution are minimized and held within legal limits. The completed job shall be workmanlike and present a good appearance.

PLANNING CONSIDERATIONS FOR WATER QUANTITY AND QUALITY

Quantity

1. Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, and deep percolation.

2. Potential for a change in plant growth and transpiration because of changes in the volume or level of soil water.

3. Effects on downstream flows or aquifers that would affect other water uses or users.

4. Effect on the water table of the field in providing suitable rooting depth for anticipated land uses.

6. Effects on the visual quality of water resources.

7. Effects of water level control on salinity of soils, soil water or downstream water.

Quality

1. Effects on erosion and the movement of sediment, and the soluble and sediment attached substances carried by runoff.

2. Effects on the movement of dissolved substances to ground water.

3. Short-term and construction-related effects on the quality of downstream water courses.

4. Potential for uncovering or redistributing toxic material.

5. Effects on wetlands or water-related wildlife habitats.

Design Criteria

Velocity

Field ditches shall be designed to develop velocities which are nonerosive for the soil materials through which they pass. Velocities for all new ditches and all old reconstructed ditches must meet the requirements given in the Standard for Open Channel, Code 582. To assure that the requirements for channel stability are met, all channels will be checked for stability when the design velocity (using aged "n" values) exceeds the value given in the following table:

Permissible Design Velocities

Soil Texture & Unified Soil Classification Symbol	Maximum Velocity Ft./Sec.
Silts and very fine sandy loams (ML, CL-ML, SP)	1.0
Silty clay loams, fine sandy loams, sandy loams, and Loams (CL, SM)	2.0
Silty clays, sandy clay loams, clay loams and sandy Clays (CL, CH, SC)	3.0
Stiff clays and high plastic soils (CH, MH)	4.0

For checking designs to see that velocities will not exceed permissible values, a Manning's "n" no greater than 0.025 shall be used.

Hydraulic Gradient

The design hydraulic gradient for field ditches shall be determined from control points including significant high areas served by the ditches, hydraulic gradients of any lateral ditches, and the elevation of the irrigation water source.

The effects of hydraulic losses caused by culverts, bridges, irrigation structures and other obstructions in the channel sections shall be considered.

Where minimum cross section required by the construction equipment will exceed the design

cross-section, the grade of the hydraulic gradient shall be checked and adjusted to approximate that which will actually exist when the ditch is carrying the design flow.

Sideslopes

Sideslopes shall be stable, meet maintenance requirements, and be designed to meet site conditions.

The minimum design levee side slopes shall be 1½ horizontal to 1 vertical.

Minimum design side slopes of borrow areas adjacent to levees shall be ½ horizontal to 1 vertical.

Minimum design side slopes of ditches excavated below normal ground (forebays for irrigation pumps, relifts, slips, etc.) shall be 1 horizontal to 1 vertical.

When a field ditch is to be constructed on top of an embankment, the minimum design side slopes of the embankment shall be:

Height to Water Surface on

Centerline of Fill 1 /	Side Slopes of Fill
Under 3’	1½ :1
3’ – 6’	2 :1
Over 6’	2½ :1

1 / Measured from hydraulic gradient to normal ground.

Top Width of Levees

Levees constructed by dragline – The minimum design top width of levees shall be:

Levee Height (feet)	Levee Top Width (feet)
3.0 or less	2
3.1 – 5.9	3
6.0 – 8.0	4
Over 8.0	½ settled levee height

Levees constructed by blade equipment – Levees with design heights of 4 feet or less may have 0 (zero) top widths provided side slopes are 2½ :1 or flatter.

Levees with settled heights greater than 4 feet, or with side slopes steeper than 2½ :1 shall have a minimum design top widths as given for levees constructed by dragline.

Design Levee Height (feet)	Berm Width (feet)
3.0 or less	2
3.1 – 5.9	3
6.0 – 8.0	4
Over 8.0	½ settled levee height

Where old levees are leveled and new ones constructed, the above criteria applies.

The berm may be eliminated where the side slopes of the levee and the borrow are 2½ :1 or flatter. Where old levees are to be enlarged, the berm may be eliminated if, in the opinion of the technician, neither the levee nor the borrow will slough.

Ditches excavated below normal ground – No berm is required when spoil spreading is to be done at the time the ditch is constructed. Where spoil is not to be spread at this time, the minimum design berm width between the slope edge of the ditch and the toe of the spoil shall be:

Average Ditch Depth (feet)	Berm Width (feet)
4.0 or less	4
4.1 to 6	6
Over 6	10

Freeboard

Levees constructed by dragline – The design freeboard of levee fill above water level when the ditch is carrying design flow shall not be less than one third of the maximum design depth of water, and in no case less than 1.0 foot.

Levees constructed by blade equipment (other than dragline) –

1. Inverted “V” type levee

   The design freeboard of semicompacted levee fill to be constructed in the shape

of an inverted "V" with 2½ :1 or flatter sideslopes and design fill heights of 4 feet or less, shall not be less than one-third of the maximum design depth of water, and in no case less than 0.5 foot.

2. Flat top levee

Levees shall have a design freeboard of not less than one-third of the maximum design depth of water, and in no case less than 0.5 foot.

Allowance for Settlement

Levees constructed by dragline – The allowance for levee settlement shall not be less than 30 percent of the design levee height for clay and silty soils, and 20 percent for other soils.

Levees constructed by blade equipment – The allowance for levee settlement shall not be less than 20 percent of the design levee height for clay and silty soils, and 10 percent for other soils.

Cross Section – The design ditch cross section shall be set below the hydraulic gradient and shall meet the combined requirements of capacity, limiting velocity, depth, sideslopes, bottom width, and allowance for sedimentation.

Appurtenant Structure

Plans for ditches shall provide for adequate turnouts, checks, crossings, and other appurtenant structures as needed for successful operation as a conservation irrigation system. Such structures shall be designed to meet the Soil Conservation Service standard for the particular structure and type of construction involved.

Specification

See Engineering Specification, Irrigation Field Ditch.

Construction

Bridges, Culverts, and Structures

Where existing bridges are to be left without modification, the channel cross section under the bridge shall be excavated to the same cross section as the ditch immediately above.

Where new bridges are installed, they shall not obstruct flow below the hydraulic gradient, except for piling.

Erosion and water control structures, culverts, and bridges shall be installed to the sizes, lines, and grades shown in the plans.

Culverts and other conduits which will be under fills shall have minimum lengths as computed by the formula L = W ÷ 2SH where:

L = minimum culvert or conduit length
W = top width of fill over culvert
S = sideslopes of fill over culvert
H = height of fill measured from ditch bottom grade

Where applicable, provision should be made for drainage of irrigation ditches when not in use. This can usually be done by providing a capped pipe in the lower end of the irrigation ditch.

Checking for Completion

Irrigation field ditches shall be checked for completion in accordance with procedures given in "Notekeeping for Irrigation Field Ditch."

NOTEKEEPING

Design Survey

Run sufficient profiles to locate high points in field to determine the direction of field slope;

and locations of checks, turnouts, and other structures.

Construction Layout

Dragline Ditches
Set centerline stakes for alignment of irrigation ditch levees.

Centerline of ditch levees may be marked with a plow furrow.

Set height stakes on outside toe of at least one levee at 200-feet intervals, or mark fill height on outside toe stakes. Include shrinkage.

Blade Ditches
Set centerline stake for alignment of ditch bottom. Centerline of ditch may be marked with a plow furrow.

Offset reference stakes may be set every 200 fete and fill heights of levee marked on stakes. Include shrinkage. The use of these stakes is optional.

All Ditches Stake locations of structures as needed for installation.

Construction Check

Reference notes to bench marks.

Profile the completed ditch, taking rod readings on top of each levee, at least once every 200 feet. For ditches constructed with blade equipment, or those constructed below ground level, profile the completed ditch, taking rod readings at least once every 200 feet as needed to determine planned grades have been met.

Cross section completed irrigation ditch at least once every 1,000 feet, at least one cross section per ditch. The ditch shall also be cross sectioned at what appears to be it's smallest section to insure that it has required capacity.

Record dimensions and elevations of turnouts, checks, culverts and drops installed as part of the irrigation ditch. Check all culverts and conduits to determine that they have adequate sizes, lengths, and strengths.

Chain all ditches, either during the design survey, or the construction layout, or the construction check. However, lengths of ditches may be determined by pacing or scaling on aerial photographs when no REAP cost sharing is involved and payment will not be made on a yardage basis.

A tolerance of 0.2 foot below the design height (including shrinkage allowance) is acceptable for levees constructed by dragline. A tolerance of 0.1 foot is acceptable for levees constructed by blade equipment.

Where levees constructed either by dragline or blade equipment have been compacted by heavy rains prior to being checked, planned heights may be lowered by the planning technician by a reasonable amount in proportion to the estimated settlement. Where allowances are made for compaction due to rains, the local technician will note this on construction check notes.

Certifying to Rural Environmental Assistance Program

The extent of this practice to be certified is the planned quantities after it has been determined that the practice has been completed to the planned dimensions and meets specifications. Yardage shall be calculated from settled height by the cross-sectional end area method, or from approved tables. Yardage shall not be certified in excess of that actually moved.

Recording Data

Record design on Form, LA-ENG 5, Irrigation Ditch Design and Data Sheet. Field notes will be recorded in looseleaf or bound field notebooks.

Record practice name, agreement number, REAP referral number, and draw sketch of field and location of surveys on bound or looseleaf field notebook paper.

Check the notes carefully to determine that all specifications have been met. Date and sign statement, "This practice meets specifications." Note any exceptions.

Recording Completed Practice

Show completed irrigation ditches in red on field office copy of conservation plan map, or, if not available, on aerial photograph or overlay.

Filing Notes and Records

See National Handbook for Resource Conservation Planning, Louisiana Supplement.